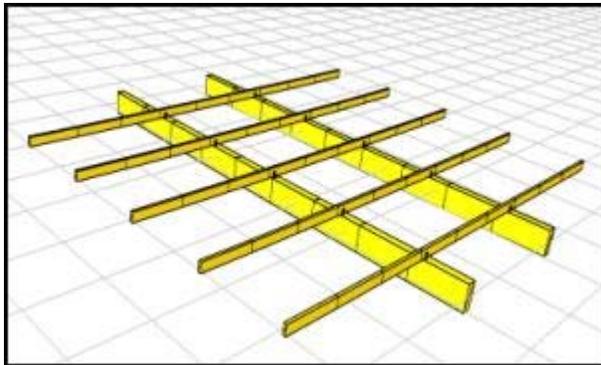


## Modeling Stacked Beams

### *Rigid Links to the Rescue*

Here is a very simple and perhaps common building technique that turns out to be rather tricky to model with a finite element program like [VisualAnalysis 5.5](#). Thanks to Ken Gaston from Bellingham WA, who posed this little challenge to [IES technical support](#).



### The Problem

Say you have a beam running east-west, now you stack on top of that a beam running north-south. The two are simply connected, yet they are both continuous bending elements and the top beam only transfers shear to the lower beam--no bending moment or twisting moments. How should you model it?

### A Solution

One possible solution involves using a **rigid-link** element to model the connection. (This is similar to the **scissors-joint** technique described in our [FAQ](#).) Model your beams at different elevations. Split the members where they would cross if they were at the same elevation. (They will automatically be modeled as Combined Members in VisualAnalysis 5.5.) Then connect them with a short rigid link. The rigid link should be relatively stiff, and the moments at one end should be released to prevent moment transfer between your two "real" beam elements.

### CONTENTS

[Modeling Stacked Beams](#)  
[Deep Beams](#)  
[Masonry Design Software](#)  
[Updates](#)  
[Back to School Blobs!](#)  
[Web Site Preview](#)  
[Quick Links](#)

## Deep Beams

### *Shear Deformation Effects*

Remember taking Strength of Mechanics way back in your sophomore year in college. The textbook derived the deflections of a beam due to bending and started out with a number of key assumptions like "*plane cross sections remain plane*", and "*shear forces do not contribute significantly to the overall deformation*".

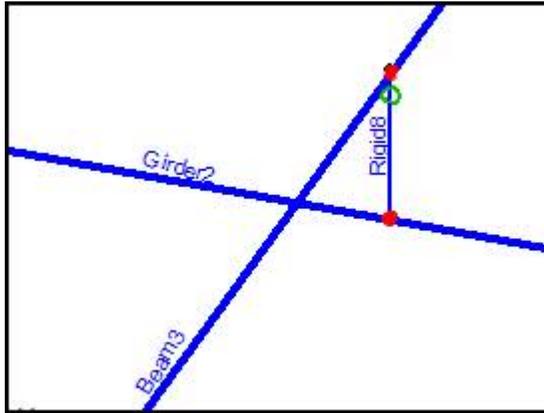
### The Technicalities

You may recall though, that for short, deep beams we cannot ignore the shear deformations.

We won't go over all the mathematics again here, you have plenty of old textbooks to dust off if you are so inclined. Roark [ISBN 007072542X] has a nice summary of the results, with only a single integral sign and one partial differentiation symbol to skim over (page 166 in the 7th Edition). The solution involves the concept of a shear-area or shear-factor. For another thorough discussion of shear areas please see Gruttman, F. and W. Wagner. [Shear correction factors in Timoshenko's beam theory for arbitrary shaped cross-sections](#). Computational Mechanics No. 27, p. 199-207, 2001.

### How to Use VA Shear Areas

In [VisualAnalysis 5.5](#), shear



### Watch Out for Instabilities

When introducing rigid links into your model, you will need to be careful to include enough supports or to minimize extra end-releases to avoid instability problems. For example, the beam elements will not be restrained against any torsion at the intersection points, so you may need to include a torsional restraint at one end of the beam. This is true even if the beams are not loaded in a way that would cause torsion. You need to take care of the mathematical instabilities that could arise in the stiffness equations.

### A Complete Example Project

If you would like to see this solution in a complete model in VisualAnalysis 5.5 (this file will not open in prior versions), you may download and unzip this: [stacked-beams.zip](#)

[Back to Contents](#)

### Back to School Blobs

*Terry Succumbs to Academic Pressure*

I (Terry) was taken to task by the professors this Fall when I tried to give schools an 'upgrade' from VisualAnalysis 4. It seems that those in the *Ivory Towers* just cannot teach students how to design buildings without resorting to members that look like, well, we can't show you a picture because they don't really have a shape! Perhaps this picture will help:



Those of us who model *real-world* structures (or at least do so vicariously through real-world engineers) usually build models using W shapes in steel, rectangles in wood or concrete, and the like. IES accordingly offers a large database of manufactured shapes.

### The Proper IES Method

We also provide a great utility program in [ShapeBuilder](#) to construct cross-sections and calculate geometric and structural properties of other, more complicated or less popular shapes. This tool helps you create a shape and save it in the IES database for use on future projects. Shapes you create in ShapeBuilder will actually render correctly in the VisualAnalysis Picture View and, if defined completely, can in many instances work in VisualDesign as well.

deformations in members are **not** automatically taken into account. If you have the 'Advanced' level of VisualAnalysis you can get the software to include them by following this procedure:

1. Update to Build 7, if you haven't already.
2. Go to **Tools | Customize Behavior**, on the **Analysis** tab, and make sure the last option on the tab is enabled.
3. Define your members with shapes that include non-zero 'Shear Areas'. You can use "[Custom Blobs](#)", or modify the shape database using *ShapeBuilder* or the *Shape Database Editor*.

[ShapeBuilder 4.0](#) can calculate the appropriate shear areas for you, if you apply a load in one direction and do an advanced analysis.

### What Exactly Does VA Do?

VisualAnalysis 5.5 incorporates the shear area by including a term in the beam's stiffness matrix which allows "shear deformation". The shear area you enter is related to the shear deflection under a unit load by the following equation:

$$\Delta = L / (G * SA)$$

$\Delta$  = Deflection/Unit load

L = Beam Length

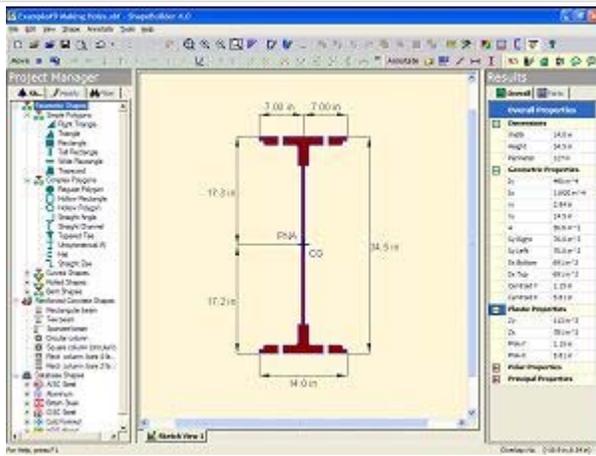
G = Shear Modulus

SA = Shear Area

While VisualAnalysis 5.5 allows this increased flexibility due to shear deformation, please note that the stress calculations done are still based on the assumptions that "*plane sections remain plane*", i.e. they vary linearly across the cross-section. This assumption is certainly **not true** for deep beams.

### A Better Solution: Plates

In summary, VisualAnalysis 5.5 gives you a method for **approximating** the stiffness reduction due to shear deformation but **does not** adequately represent stress values for deep beams. To get



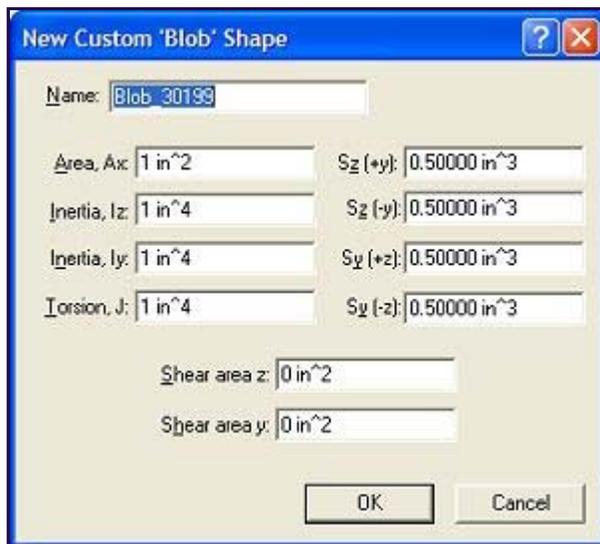
There is also the *Shape Database Editor*, included with ShapeBuilder, that allows you to create custom shapes without actually defining the shape, or for importing entire libraries of foreign shapes. You can even share your slick new database with the engineers down the hall (assuming they have [purchased a license](#) to use IES software).

### Uncle! Uncle!

It turns out, though, that **I was wrong**. I admit it. It took me three years, and lots of discussions with many engineers and staff members at IES. **Philosophically**, I am still very much opposed to indistinct shapeless forms. But frankly, I'm just plum tired of trying to defend the position. *You really do need the feature, please forgive me for removing it!*

### Rebirth of a Feature

In repentance, I have re-introduced, the "User-Defined Shape", or the "Custom Shape" feature, in a slightly different form into VisualAnalysis 5.5 Package (Build 7). Because these are **indistinct shapeless** forms, they are dubbed "Custom Blobs".



### Blob Feature Details

In this initial release you may create blobs, give them a name and properties, and re-use them for other members in the same project. Shear-area properties are only available in the 'Advanced' level of VisualAnalysis. Blobs are saved with the project file, but are not available to other projects. Once created, you cannot edit them, but of course if you get it wrong you can easily create more and more blobs.

the most accurate model for deep beams, it is recommended that you use plate elements (several across the depth and width of the beam). This will eliminate the need for an estimated shear area and will provide an accurate stress and deformation solution for the problem.

[Back To Contents](#)

### Updates

*Bug fixes, defect corrections.*

On the one hand we are slightly embarrassed to release another update. On the other hand, we are pleased to be able to provide nearly immediate support for customers that have run into bumps along the software road.

- VisualAnalysis 5.5 Package, Build 9
- ShapeBuilder 4.0, Build 9

Install the updates through the software, or if that does not work, then go directly to the web site to install them: [www.iesweb.com/install.htm](http://www.iesweb.com/install.htm).

### Combined Members Fixes

VisualAnalysis 5.5 introduced a much more comprehensive version of Combined (Physical) Members this summer. The latest update is "critical" to making sure this feature behaves properly for you. There have been a number of scenarios that could cause models to become unstable or ill-defined when using the combined member. The latest "build 9" corrects all such known problems and is therefore highly recommended!

### Free Features!

Sometimes updates include a new feature or two. The latest VisualAnalysis update included two:

- [Custom Blobs](#)
- Shape "Quick Pick" List

Both features are found under the **Project Manager's Modify** tab for member

If the blob shape is not used by any members, it will automatically be removed when the file is closed and reopened. In a Picture View they will display as a rectangle or square proportional to the properties you have defined--watch out for HUGE properties!

### What a Grumpy Old Man...

Go ahead and model the whole world with BLOBS if you like! **Just don't tell me about it.** If I start having to do technical support for Blobs, you may get some **indistinct shapeless** answers!! I won't be holding my breath waiting for photos of all the blob-based structures you will be constructing either.

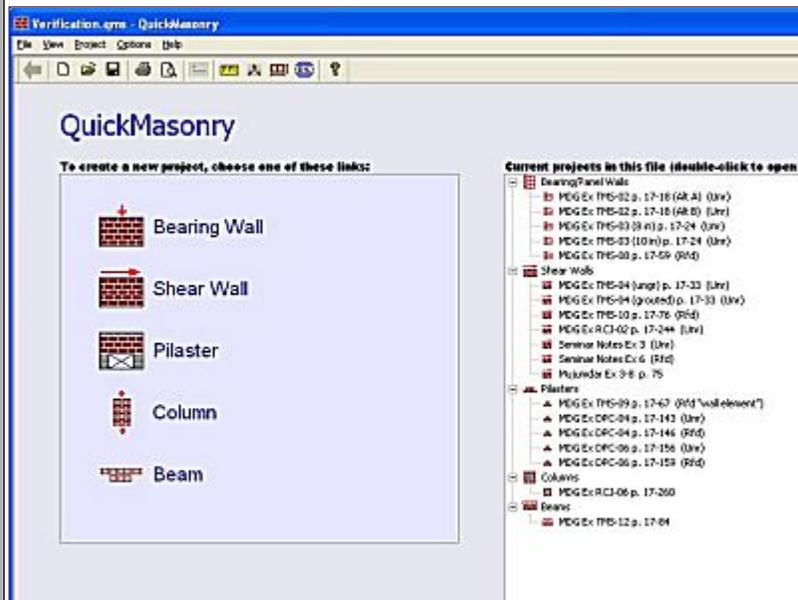
It sure is a good thing students are still somewhat teachable once they graduate.

[Back To Contents](#)

## Masonry Design Software

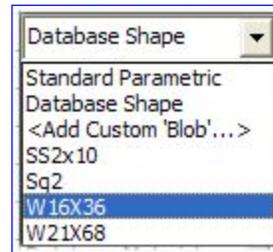
*Walls, Lintels, Pilasters, Shear Walls, Beams & Columns!*

When we asked you last Fall what you wanted from IES, the answer was clear: [Masonry Design](#). IES has a new tool coming soon that stacks up well in our current product lineup, and will act like grout in the cracks between our other tools.



The forthcoming **QuickMasonry** follows MSJC requirements to provide easy design checks and organization for all of the masonry components in your structures. With the same kind of clarity and quality as our other Quick products, the new tool will be immediately familiar to many.

elements.



For those of you running the 'Advanced' level of VisualAnalysis, you will now find that the former "Moving Load Tool" is incorporated directly into VisualAnalysis.

### Please Tell Us...

If you are having any problems with IES software, whether it be crashes, hangs, performance issues, strange behavior, confusing documentation, or (heaven forbid) incorrect results: we want to know about it, at least on the one hand.

[Back To Contents](#)

## New Web Site!

*Content! Content! Content!*

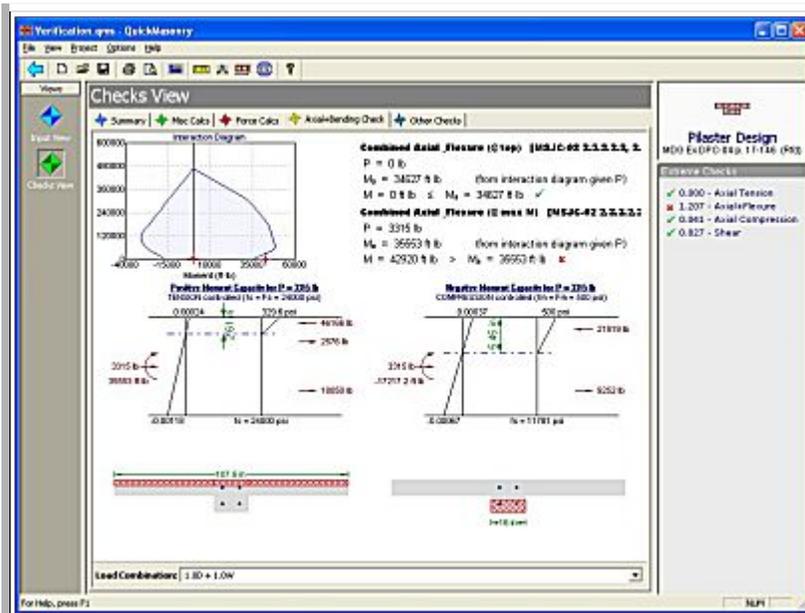
The new iesweb.com is now up and running. We have put on a fresh new face, renamed and regrouped some products, increased some prices (though not for upgrades), and tried to make things much easier to find than before.

The new site is not completely finished, but is so much better than the old one that we have decided not to wait.

Many pages have changed locations, so if you have stored bookmarks to places on the old site, you may wish to update those. Most of the 'primary' pages remain in the same locations and the new navigation system should help you track down the rest.

Please take a few minutes to look over the site and then drop us an email to let us know whether your first-impression was good, bad, or indifferent.

[New IES Web](#)



If you have ideas or suggestions please let us know. Please send your comments to [IES Technical Support!](#)

[Back To Contents](#)

**Quick Links:**

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- [Secure Order Form](#)
- [Online Technical Support](#)
- [Send Email to IES Support](#)
- Sales phone: 800-707-0816

The QuickMasonry product will be available in the fourth quarter of this year. The product will be entering "beta testing" shortly. We have not yet set pricing on this product or made it available for pre-ordering. Watch for further updates in October or early November.

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